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An Annotated Bibliography from a Literature Search on Deep Mining

Une bibliographie annotée constituée à partir d'une étude de la documentation portant sur le minage à grande profondeur

John E. Udd
MMSL / LMSM

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Databases

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Background

In 1998, the Mining Laboratories of the Mining and Mineral Sciences Division (MMSL), of CANMET, initiated a new core research project on "Deep Mining". Against the background that the successful mining or orebodies at depth is rapidly becoming an issue of high priority in the Canadian mining industry, the decision was made to mobilize some of the Division's resources in order to address these emerging challenges.

As a part of this major research project, the writer was asked to compile the most complete bibliography possible from searches through the world literature on the subject of **Deep Mining**.

Subsequently, through participating in a trial arrangement made by the CANMET Library, it became possible to search through the databases accessible through the Dialog Corporation's DialogWeb™ (1998) search engine.

In early March, 1999, the search through the worldwide mining databases linked to Dialog was begun. The results, which numbered in the many hundreds of citations including the linked words "deep mining", were drawn from no fewer than 24 databases. Arranged alphabetically, these were:

Contexte

En 1998, les Laboratoires miniers de la division de la Science des mines et des minéraux (LMSM) de CANMET a entrepris un nouveau projet de recherche de base sur le «minage à grande profondeur». Dans une situation où l'exploitation minière réussie de corps minéralisés à une grande profondeur devient rapidement un domaine de priorité élevée pour l'industrie minière canadienne, on a pris la décision de mobiliser des ressources de la division afin de relever ces nouveaux défis.

Dans le cadre de cet important projet de recherche, on a demandé au rédacteur de ce document de constituer la bibliographie la plus complète possible à partir de recherches faites dans la documentation mondiale et portant sur le **minage à grande profondeur**.

Par la suite, en participant à une entente expérimentale conclue par la bibliothèque de CANMET, a été possible de faire des recherches en utilisant les bases de données accessibles grâce au moteur de recherche DialogWeb™ (1998) de Dialog Corporation.

Au début de mars 1999 ont commencé les recherches effectuées en utilisant les bases de données mondiales sur l'exploitation minière reliées à Dialog. Les résultats, qui ont atteint plusieurs centaines de citations incluant la chaîne de mots «deep mining» (minage à grande profondeur), parvenaient de pas moins de 24 bases de données. Les voici classées par ordre alphabétique.

AESIS (Australia's Geoscience, Minerals and Petroleum Database)
ANTE (Abstracts in New Technologies and Engineering) (© 1999 Reed-Elsevier (UK) Ltd.)
Aluminum Industry Abstracts (© 1999 Cambridge Scientific Abstracts)
Dissertation Abstracts Online (Dissertation Abstracts International) (© 1999 UMI)
Ei Compendex®) (Engineering Information Incorporated)
Energy, Science and Technology (©1998)(Energy SciTec)
Enviroline® (© 1998 Congressional Information Service)
Environmental Bibliography (© 1999 International Academy at Santa Barbara)
FLUIDEX (Fluid Engineering Abstracts)(©1999 Elsevier Science Ltd.)
FEDRIP (Federal Research in Progress)
GEOBASE(TM) (© 1999 Elsevier science Ltd.)
GeoArchive (© 1999 Geosystems)
GeoRef (© American Geological Institute)
ICONDA (International Construction Database)
Inside Conferences (© 1999 BLDSC)
JICST-EPlus (Japanese Science and Technology Corporation)(JST)
METADEX® (Metals Science)(© 1999 Cambridge Scientific Abstracts)
NTIS (National Technical Information Service)
PASCAL
SciSearch® (a Cited Reference Science Database - 1974-1989)(© 1999 Institute for Scientific Information)
SciSearch® (a Cited Reference Science Database - 1990 -)(© 1999 Institute for Scientific Information)
TULSA(TM) (Petroleum Abstracts) (© 1999 The University of Tulsa)
TULSA(TM) (Petroleum Abstracts - subscribers)
Wilson Applied Science & Technology Abstracts (©1999 The H. W. Wilson Co.) A

To these can be added CANMET's MINTECH (Mining Technology) Database, which was maintained by the CANMET Library for many years. It, however, was discontinued in the mid 1990s as the result of Program Review.

Subsequently, other databases have been added through personal contacts. These include: (1) an "Index of Papers and Discussions from 1931" of the Association of Mine Managers of South Africa and (2) the "Database of O.I.P.E.E.C. Technical Publications 1963-1998", provided by the International Organisation for the Study of the Endurance of Ropes. These have both been invaluable in making reference to hard-to-find early publications. The assistance of Mike O'Brien of CSIR Miningtek, in Johannesburg, South Africa, and Dr Isabel M. L. Ridge, of the University of Reading, Reading, United Kingdom, in providing these databases is gratefully acknowledged. Reference to both, in this publication are as follows:

On peut y ajouter la base de données MINTEC de CANMET (Technologie minière), que la bibliothèque de CANMET a tenu à jour pendant de nombreuses années. Toutefois, à la suite de l'Examen des programmes, elle a été abandonnée au milieu des années 1990.

Par la suite, d'autres bases de données se sont ajoutées grâce à des contacts personnels. Elles incluent : 1) un «Index of Papers and Discussions from 1931» de l'Association of Mine Managers of South Africa et 2) la «Database of O.I.P.E.E.C. Technical Publications 1963-1998», fournie par l'Organisation internationale pour l'étude de l'endurance des câbles. Ces deux sources documentaires ont été précieuses afin de consulter des publications déjà anciennes difficiles à trouver. Nous sommes reconnaissants à Mike O'Brien de CSIR Miningtek, à Johannesburg, Afrique du Sud, et au professeur Isabel M.L. Ridge, de l'University of Reading, Reading, Royaume-Uni, de l'aide qu'ils nous ont apportée pour nous fournir ces bases de données. La référence à cette documentation est faite comme suit dans cette publication :

AMMSA (Association of Mine Managers of South Africa)

OIPEEC (Organisation for the Study of the Endurance of Ropes/Organisation Internationale pour l'Etude de l"Endurance des Cables).

The Approach

Following the searches, printouts were made of the full details that were given for each of the references identified as containing the key words (deep(w)mining). For the most part, these included the abstracts of the works. Many databases, however, are accessible only on a "fee-for-use" basis with the abstracts being considered as proprietary intellectual property. Thus, these are not included in this report. Readers wishing to have either the abstracts or the complete papers should either request these through an interlibrary loan or to make arrangements to purchase copies through the sources identified.

Notwithstanding this, the writer has read the abstracts and has then classified the references according to the technological issues that accrue to deep mining. In this bibliography these are identified as the major headings. These are subjective and it is possible that others should be identified. The writer would welcome any comments through which the presentation could be improved.

Within each section, the works have been listed alphabetically for the first-mentioned author (normally considered to be the senior author). The information included in this report is:

(1) the name(s) of the authors(s), with surnames first.
(2) the title of the work, in the language in which it appeared. The translations of titles are included wherever available.
(3) the source in which it can be found, ie. Journals, Symposia or Conference Proceedings, Books.
(4) the location and date of the event, if a

La méthode

Après les recherches, nous avons fait des imprimés donnant les détails complets de chaque référence identifiée comme contenant les mots clés (deep(w)mining). Dans la plupart des cas, ils incluaient un résumé analytique des documents. Cependant, plusieurs bases de données ne sont accessibles qu'avec des droits d'utilisation, les résumés étant considérés comme propriété intellectuelle exclusive. Ils ne sont donc pas inclus dans ce rapport. Les lecteurs qui voudraient disposer des résumés ou des documents complets devraient les demander par l'entremise d'un prêt entre bibliothèques ou prendre des dispositions pour acheter des exemplaires par le truchement des sources identifiées.

Malgré cela, le rédacteur a lu les résumés et a ensuite classifié les références d'après les questions technologiques relatives au minage en profondeur. Dans la présente bibliographie, ils sont identifiés comme rubriques importantes. Ils relèvent de choix subjectifs et il est possible qu'il faille en identifier d'autres. Le rédacteur accueillerait volontiers tout commentaire permettant d'améliorer la présentation.

Dans chaque section, les documents sont présentés en ordre alphabétique du premier auteur mentionné (généralement considéré comme l'auteur principal). Voici les renseignements incluent dans ce rapport :

(1) le nom ou les noms de l'auteur ou des auteurs, le patronyme apparaissant en premier;
(2)le titre du document, dans la langue dans laquelle il est présenté; les traductions des titres sont incluses lorsqu'elles sont disponibles;

Symposium or Conference.
(5) the publisher of the work.
(6) the ISSN or ISBN number, if available.
(7) the volume, number of the issue, month of issue, and date of publication, if available.
(8) the pages on which the work appeared.
(9) a citation to the database(s) in which the information was found. These do not include any catalogue numbers.

After reading the abstracts, the writer made a subjective decision concerning how the work would be classified in this database. Within each title, certain key words and phrases have be highlighted in boldface type in order to draw the reader's attention to what this writer has identified as the principal thrust(s) of the work. It is to be emphasised that this highlighting did not appear in the original published manuscript. Rather, it is this writer's means of making key information stand out conspicuously. Once again, any suggestions for improvements would be welcomed.

The bibliography is intended to serve a wide audience - namely all of those who may be interested in the subject of Deep Mining. This audience might include not only Mining Engineers, but also those who have considered using deep mines for purposes other than the extraction of ore - such as experiments in particle physics (neutrinos) and civil defense (warfare).

From mining engineering perspective, however, the mining of orebodies at depth is made exceptionally difficult for a number of reasons. First, ambient rock stresses increase to the point when sudden explosive failures, or rockbursts, become much more likely. High rock stresses are inevitable at great depth.

(3)la source dans laquelle on peut le trouver, c.-à-d., revues, actes de symposium ou de conférence, livres;
(4)le lieu et la date de l'événement, s'il s'agit d'un symposium ou d'une conférence;
(5)l'éditeur du document;
(6)le numéro ISSN ou ISBN, s'il est disponible;
(7)le volume, le numéro, le mois et la date de la publication, s'ils sont disponibles;
(8)les pages dans lesquelles se trouvent le document;
(9)une mention de la base de données ou des bases de données dans laquelle ou lesquelles les renseignements ont été trouvés. Les numéros de catalogue ne sont pas inclus.

Après la lecture des résumés, le rédacteur a pris des décisions subjectives à propos de la classification d'un document dans la présente base de données. Dans chaque titre, des mots et des expressions clés ont été mis en évidence en caractères gras afin d'attirer l'attention du lecteur sur ce que le rédacteur a identifié comme le point principal ou les points principaux du document. Il faut souligner que cette mise en évidence n'apparaît pas dans le manuscrit original qui a été publié. C'est plutôt le moyen choisi par le rédacteur pour que les renseignements clés ressortent de façon manifeste. Une fois encore, toute suggestion pour l'amélioration sera la bienvenue.

La bibliographie s'adresse à un large public, à savoir toutes les personnes qui s'intéressent au minage en profondeur. Ces personnes peuvent comprendre non seulement les ingénieurs des mines, mais aussi celles qui ont envisagé d'utiliser des mines profondes dans des buts autres que l'extraction de minerai - comme les expériences concernant la physique des particules (neutrinos) et la

Second, as rock stresses increase, so too do ambient rock temperatures. Geothermal gradients are such that deep mines are also hot mines.

The combination of this heat and the water that is used for mining processes inevitably results in very high humidity. Thus, and third, the underground working environment is challenging in the extreme.

Finally, and fourth, for all of these reasons, the costs of mining at depth inevitably become the principal reason that deep mines are closed. With labour becoming more and more inefficient as the ambient atmosphere becomes more harsh, and with the costs of transporting the workers, materials, and ore through great distances becoming progressively more costly as depth increases, there must ultimately come a point when the venture must be abandoned. It is only through advanced technology to address the challenges that the lives of operations at depth can be extended.

The Construction of the Bibliography

As the first step in the construction of the Bibliography, the writer began with the information that had been obtained from the search of CANMET's MINTECH. To this, was shortly added the data from NTIS, the National Technology Information Service of the United States Department of Commerce.

The result of this was a document of approximately 60 pages. This was issued as MMSL Divisional Report 99-011 (LS) in order to serve as a report on progress to the Project Team of the Deep Mining Core Project.

During the months that followed, the

défense civile (guerre).

Cependant, dans la perspective du génie minier, l'extraction en profondeur de gisement de minerai est rendue exceptionnellement difficile pour un certain nombre de raisons. Tout d'abord, les contraintes ambiantes existant dans les roches s'accroissent jusqu'à un point où des ruptures explosives soudaines ou des coups de toit deviennent beaucoup plus probables. À une grande profondeur, les contraintes élevées exercées sur la roche sont inévitables.

Ensuite, à mesure que s'accroissent les contraintes de la roche, s'accroissent aussi les températures ambiantes de la roche. Les gradients géothermiques sont tels que les mines profondes sont aussi des mines chaudes.

La combinaison de cette chaleur et de l'eau utilisée dans les procédés d'extraction entraîne inévitablement une humidité très élevée. Et donc, en troisième lieu, l'environnement souterrain de travail pose de très grands défis.

Finalement, en quatrième lieu, pour toutes ces raisons, les coûts des opérations minières en profondeur deviennent inévitablement la principale raison pour laquelle les mines profondes sont fermées. La main-d'œuvre devenant de plus en plus inefficace à mesure que l'atmosphère ambiante devient plus difficile et les coûts du transport des travailleurs, des matériaux et du minerai sur de grandes distances devenant progressivement plus onéreux à mesure que la profondeur s'accroît, on en arrive finalement à un point où il faut abandonner l'entreprise. Ce n'est que grâce à une technologie de pointe capable de relever ces

references identified from the searches of many other major databases were added. The present report is, therefore, a "snapshot in time" and represents the status of the database as of its date of issue. The work continues at a fairly brisk pace.

Once the abstracts on hand have been reviewed, every effort will be made to include as many references as possible that are not included therein. These will probably include many of the papers and articles that were written during the first seven decades of the 20th Century, and which were not included in the databases listed previously. It is to be noted that few of these contained references earlier than the mid 1960s to early 1970s - the period during which computers were coming into widespread use and databases being created.

On November 17, 2000, the writer had the opportunity to make a thorough review of all of the issues of the CIM Bulletin (and its predecessors) that had been published by the Canadian Institute of Mining, Metallurgy and Petroleum during the period 1898 to 1965. As a result, many references which were published by the CIM, and which were not contained in the databases mentioned, were captured. These have been added to the bibliography.

Finally, as a further step conducted during the year 2001 the writer also examined the Proceedings of the Deep Mining Sym,posium (which tool place in the Republic of South Africa in 1990) together with the Proceedings of other symposia - including most in the series that were held in the United States of America.

These further searches produced many additional references - not only of papers

défis que l'on peut prolonger la vie des opérations en profondeur.

La réalisation de la bibliographie

Comme première étape de la réalisation de la bibliographie, le rédacteur a commencé avec les renseignements obtenus de la recherche de MINTEC de CANMET. Y furent bientôt ajoutées les données du NTIS, le National Technology Information Service du United States Department of Commerce.

Il en est résulté un document d'environ 60 pages. Il a été publié comme Rapport de division du LMSM 99-011 (LS), afin de servir de rapport d'étape à l'équipe de projet du Projet de recherches de base sur les opérations minières en profondeur.

Les références identifiées dans les recherches faites dans plusieurs autres bases de données importantes ont été ajoutées au cours des mois qui ont suivi. Le présent rapport représente donc un instantané de la base de données à la date de sa version. Le travail se poursuit à un rythme assez rapide.

Une fois les résumés disponibles examinés, tous les efforts seront déployés afin d'ajouter autant de références non encore incluses que possible. Elles comprendront probablement plusieurs articles ou essais rédigés au cours des sept premières décennies du XXe siècle, et qui n'ont pas été inclus dans les bases de données mentionnées plus haut. Il faut remarquer qu'il y en a peu qui contiennent des références antérieures à la période allant du milieu des années 1960 au début des années 1970 - période au cours de laquelle s'est répandue l'utilisation des ordinateurs et la création de bases de données.

Le 17 novembre 2000, le rédacteur a eu

that had not been included in the databases but also of references to the papers which the writer felt should be included in this bibliography.

Thus, throughout this document there are numerous references that are not followed by a citation of a database. These have been obtained from other sources, notably journals, books, and conference proceedings that have been available for inspection by the author. Unfortunately, though, the writer encountered significant variations in the standards by which references were listed. In many cases key information was lacking - most particular, either the country or origin, or the full name of the book or journal, or the full pagination, or ISBN or ISSN numbers. In many instances, after comparisons with other citations for the same author, it is believed that names were mis-spelled. This writer has made every effort to ensure that the listings are accurate.

In spite of this, all of the secondary references were included. The writer acknowledges that, as the result of this, some further searching will probably be necessary on the part of those using this bibliography. Furthermore, the accuracy of the citation of references that have neither originated from databases nor works actually seen can not be guaranteed. Nonetheless, in the interests of making the work as complete as possible, these have been included.

Persons using this database, and finding errors or omissions, are encouraged to bring these to the attention of the writer at: judd@nrcan.gc.ca

Finally, ISBN and ISSN numbers became available starting about the mid-1970s. Thus, such numbers are not cited in the

l'occasion de faire une examen approfondi de tous les numéros du Bulletin de l'ICM (et de ses prédécesseurs) publiés par l'Institut canadien des mines, de la métallurgie et du pétrole, de 1898 à 1965. Plusieurs références publiées par l'ICM et qui ne se trouvaient pas dans la base de données mentionnée ont ainsi pu être saisies. Elles ont été ajoutées à la bibliographie.

Finalement, comme tâche complémentaire réalisée au cours de l'année 2001, l'auteur a aussi examiné les comptes-rendus du Symposium on Deep Mining, tenu en République d'Afrique du Sud en 1990, et ceux d'autres symposiums, la plupart tenus aux États Unis d'Amérique.

Ces recherches ont pruduit de nombreuses références additionnelles, non seulement celles qui n'ont pas encore été inclues à l'intérieur des bases de données consultées à venir jusqu'à aujourd'hui, mais également des références citées par les auteurs des articles nouvellement recensés et qui méritaient d'être inclues à l'intérieur de la présente bibliographie.

Par conséquence, dans le cours du document se trouvent de nombreuses références qui ne sont pas suivies de la mention d'une base de données. Elles ont été obtenues d'autres sources, en paticilier de revues, de livres et d'actes de conférences, que le rédacteur a pu consulter. Malheureusement, l'auteur a aussi rencontré des variations importantes dans la manière dont les références étaient compilées. Très souvent, des informations clé étaient manquantes - plus particulièrement, soit le pays ou l'origine de l'article, le nom complet du livre ou de la revue, la pagination complète, ou encore les numéros d'enregistrement ISBN ou ISSN. En maintes occasions, après comparaison

earlier references. To facilitate searching, however, the author has compiled a list of the numbers which have been assigned to many, if not most, of the major publications and publishing houses cited in this bibliography. These are as follows:

avec d'autres citations pour un même auteur, on aura découvert des erreurs d'orthographe dans le nom des auteurs cités. Tous les efforts ont été fait pour assurer l'exactitude des entrées à l'intérieur de la présente bibliographie.

Malgré ce fait, toutes les références secondaires ont été inclues. Comme résultat, l'auteur reconnaît qu'une recherche plus longue sera probablement nécessaire de la part des personnes qui utiliseront cette bibliographie. De plus, l'exactitude des entrées qui ne proviennent pas de bases de données ou de compilations existantes ne peut être assurée. Néanmoins, dans le souci de rendre le présent travail aussi complet que possible, toutes les références ont été inclues.

Les usagers de cette bibliographie sont encouragés à faire parvenir les erreurs ou les omissions à l'auteur à judd@nrca.gc.ca.

Finalement, les numéros ISBN et ISSN sont devenus disponibles vers le milieu des années 1970. Ces numéros ne sont donc pas indiqués dans les références antérieures. Cepedant, pour facilité les recherches, l'auteur a compilé une liste de numéros qui ont été attribués à plusieurs - sinon à toutes - publications importantes et maisons d'édition citées dans cette bibliographie. Les voici:

Compendium of ISBN and ISSN Numbers Publications

Liste de numéros ISBN et ISSN Publications

Acta Geodaetica, Geophysica et Montanistica Hungarica (in Hungarian)
ISSN 0236-5758

American Congress on Surveying and Mapping
ISSN 0748-3244

Arch. Gorn (in Polish)

AusIMM, Bulletin, Australasian Institute of Mining and Metallurgy
ISSN 0314-6154 (Became ISSN 1034-6775)

Australian Mining
SSN not found

Berg Huettenmaenn Monatsh
ISSN 0005-8912

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Bezopasnost Truda v Promyshlennosti (USSR) (in Russian)
ISSN 0409-2961

Braunkohle (Dusseldorf) (in German)
ISSN 0341-1060

Brennst Waerme Kraft (in German)

British Coal
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Bulk Solids Handling
ISSN 0173-9980

Canadian Mining Journal
ISSN 0008-4492

Certified Engineer
ISSN 0009-0409

China Coal Society (in Chinese)
ISSN 0253-9993

China University of Mining and Technology (Journal)(in Chinese)
ISSN 1006-1266

CIM Bulletin, Canadian Institute of Mining, Metallurgy and Petroleum
ISSN 0317-0926

Civil Engineering/Sivele Ingenieurwese (South African Institute of Civil Engineers)
ISSN 1921-2000

Coal
ISSN 1040-7820

Coal Age
ISSN 0009-9910 (Became ISSN 1040-7820)

Coal Focus (Canada)
ISSN 0821-7060

Coal International (Redhill, United Kingdom)
ISSN 1357-6941 (Became ISSN 0264-9799), now merged with Mining and Quarry World

Coal Science and Engineering (Journal)
ISSN 1006-9097

Coal Science and Technology (in Chinese)
ISSN 0253-2336

Coal UK (London)
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Colliery Guardian
ISSN 0010-1281

Delft Progress Report (Netherlands)
ISSN 0304-985X

Dopovidi Akademii nauk Ukrainskoi (in Ukrainian)

Economic Geology Bulletin
ISSN 0013-0109

Engineering and Mining Journal
ISSN 0095-8948

Fiziko-Tekhnicheskie Problemy Razrabotki Poleznykn Iskopaemykh (in Russian)
ISSN 0015-3273

Foldrajzi Ertesito (Hungary)

Geologicky Pruznum (in Czech)
ISSN 0016-772X

Gerlands Beitrage zur Geophysik

Gigiena Truda i Professional'nye Zabolevaniya (in Russian)
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Glueckauf (in German)
ISSN 0340-7896

Glueckauf-Forschungshefte (in German)
ISSN 0017-1387

Glueckauf Translations (in English)
ISSN 0174-1799

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International Applied Mechanics (USA)
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International Coal Report (UK)
ISSN 0260-4299

International Journal of Refrigeration - Revue Internationale du Froid

International Journal of Rock Mechanics and Mining Sciences & Geomechanics Abstracts
ISSN 0148-9062

Izvestiya Vysshikh Uchebnykh Zavedenij, Gornyj Zhurnal (in Russian)
ISSN 0536-1028

Journal of Energy and Natural Resources Law (UK)
ISSN 0264-6811

Journal, Institution of Engineers, India

Journal, Mines, Metallurgy and Fuels (India)
ISSN 0022-2755

Journal, Mine Ventilation Society of South Africa
ISSN 0368-3206

Journal of Mines, Metals and Fuels (India)
ISSN 0022-2755

Journal. Mining and Material Processing

Institute of JapanISSN 0916-1740

Journal of Petroleum Technology
ISSN 0022-3522

Journal, Royal Agricultural Society of England

Journal, Royal Astronomical Society (UK)
ISSN 0016-8009

Journal, South African Institute of Mining and Metallurgy
ISSN 0038-223X

Landmarc (Washington, USA)
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Les Techniques de l'Industrie Minérale (France)
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Mechanizacja I Automatyzacja Gornictwa (in Polish)
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Meitan Kexue Jishu (see Coal Science and Technology, above)

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Metall Rev MMIJ
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Mine, Petrol si Gaze (in Romanian)
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Mines magazine (Colorado School of Mines, USA)
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Mining Congress Journal (United States)
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Mining Engineer (London) (United Kingdom)
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Mining Engineering (Littleton, Colorado)
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Mining Environmental management (UK)
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Mining in South Africa
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Power in Europe (1988) (United Kingdom)
ISSN 0955-6079

Power Engineering
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Scottish National Heritage Review
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South African Mining, Coal, Gold and Base Metals
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Transactions, Industrial Applications, IEEE
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Zeszyty Naukowe Politechniki Slaskiej,

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